7.   (Amended) The arrangement as claimed in claim 6, further comprising an adder which is fed said control signal and said digital signal, an adder output being fed to a modulation input of said modulator.

REMARKS

The present Amendment revises the specification and claims to conform to United States patent practice, before examination of the present PCT application in the United States National Examination Phase. Pursuant to 37 CFR 1.125 (b), applicants have concurrently submitted a substitute specification, excluding the claims, and provided a marked-up copy. All of the changes are editorial and applicant believes no new matter is added thereby. The amendment, addition, and/or cancellation of claims is not intended to be a surrender of any of the subject matter of those claims.

Early examination on the merits is respectfully requested.

Submitted by,

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PRELIMINARY AMENDMENT A

1.   **(Amended)** A method for optimizing an amplitude-modulated optical signal[(OSM)], [which is generated]**comprising the steps of:**

generating said amplitude-modulated optical signal in a modulator[(2)] by modulating an optical signal [(OS)]with [the aid of]a digital signal[(DS),]**;**

[characterized]

[in that the]**feeding said** amplitude-modulated optical signal [(OSM) is fed]to a frequency discriminator[(5)] which outputs a[spectral distribution signal][(SV),] **spectral distribution signal;**

[in that the][spectral distribution signal][(SV) is fed]**feeding said spectral distribution signal** to a control device [(6)]which is also fed [a]**an** adjustable reference signal[(RS),]**;** and

[in that the]**generating a** control signal[(SR   )] which sets [the]**an** operating point of [the]**said** modulator[(2) is generated] by comparing [the two signals]**said adjustable reference signal and said spectral distribution signal**.

[2.   ][The method as claimed in claim 1,]

[characterized]

2.   [in that]**(Amended) The method as claimed in claim 1, further comprising the step of separating** a measuring signal [(OMT)]which is fed to [the]**said** frequency discriminator[(5) is separated] from [the]**said** amplitude-modulated optical signal[(OSM)].

3.   **(Amended)** The method as claimed in claim [1 or 2,]**1, further comprising the steps of:**

[characterized]

[in that the]**determining said** spectral distribution signal [(SV) is determined]at [the]**a** start of a transmission path[,]**;** and [in that the]

setting said reference signal [(RS) is set taking account of the]**based on** properties of [the]**said** transmission path[(3)].

4.   **(Amended)** The method as claimed in claim [1 or 2,]**1, further comprising the steps of:**

[characterized]

[in that the spectral distribution signal (SV) is determined at the]**determining said spectral distribution signal (SV),at a** receiving end[,]**;** and

PRELIMINARY AMENDMENT A

[in that the spectral distribution signal (SV)]**transmitting said**   in that the **spectral distribution signal** or a control signal[(SR)] generated therefrom [is   transmitted]to [the]**said** modulator [(2)]provided at [the]**a** transmitting end.

[5.   The method as claimed in one of the preceding claims,]

[characterized]

    5. [in that the]**(Amended)** 2. The method as claimed in claim 1, **wherein said** control signal[(SR)] is obtained during periodically occurring time windows[(ZF)].

    6.   **(Amended)** An arrangement for optimizing an amplitude-modulated optical signal[(OSM)], [having]**comprising:**

    a light source[(1) and]**;**

    a **modulator having an output, said** modulator [(2) to which there are]**being** fed an optical signal [(OS)]from [the]**said** light source[(1)] and a digital signal [(DS)]for amplitude modulation[,]**;**

[characterized]

    [in that the]**a** frequency discriminator[(5)] which outputs a spectral distribution signal [(SV)]**that** is [corrected]**connected** to [the]**said** output of [the]**said** modulator[(2)] via a splitter**;** [(4),]and[in that]

    a control device[(6) is provided] with a reference signal setting device [(7)]which is fed [the]**said** spectral distribution signal[(SV)] and which generates a control signal [(SR)]which controls [the]**an** operating point of [the]**said** modulator[(2)].

    7.   **(Amended)** The arrangement as claimed in claim 6,

[characterized][in that]** further comprising** an adder[is provided] which is fed [the]**said** control signal [(SR)]and [the]**said** digital signal[(DS)], [and][in that the]**an** adder output [is]**being** fed to a modulation input of [the]**said** modulator[(2)].

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[~~Description~~]SPECIFICATION

[~~Method and arrangement for optimizing of an amplitude-modulated optical signal~~]

TITLE

METHOD AND ARRANGEMENT FOR OPTIMIZING AN AMPLITUDE-MODULATED OPTICAL SIGNAL

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001]   The invention relates to [~~methods according to the preamble of patent claim 1, and to~~]**a method and arrangment for optimizing** an [~~arrangement according to the preamble of claim 6.~~]**amplitude-modulated optical signal.**

DESCRIPTION OF THE RELATED ART

[0002]   Digital signals are frequently transmitted in optical networks with the aid of amplitude modulation (ASK). A carrier wave is transmitted in the case of one logic state, and no signal**/carrier wave** is transmitted during the other logic state. [~~As early as~~]**Early in** the modulation (on-off), [~~what is termed~~]a **"chirp"** is produced [~~in~~]which **changes** the wavelength **and amplitude** of the output signal[~~, and also the amplitude thereof, are changed~~]. The transient component of the chirp causes large variations in the [~~region of the edges~~]**edge regions, and** a sharp increase or decrease[~~, (sic)~~] in the wavelength[~~,~~]**;** the switch-on edge [~~being~~]**is** of particular importance[~~,~~] since the changes occur in the case of a full signal level. The other[~~,~~] adiabatic component of the chirp can be kept small by a suitable design of the modulator.

[0003]   During transmission of [~~the~~]**a** pulse in a waveguide (glass fiber), self-phase modulation of the carrier occurs[~~,~~] **(**this being a further form of the chirp[~~,~~]**)** in which the wavelength changes likewise**,** particularly in the

leading edge region and trailing edge region of the pulse. [Amplitude]**Also, amplitude** distortions can occur[, in addition].

[0004]   The two wavelength distortions, **including** the transient component of the chirp induced by switching on, and the self-phase modulation result in pulse distortion of the baseband signal[which], **contribute** (particularly in the case of transmission systems with high bit rates[, contribute]) to limiting the data rate and the transmission range.

[0005]   An attempt is usually made to minimize the chirp-induced disturbing influences by setting operating points of Mach-Zehnder modulators or integrated electro-absorption modulators in [the]**a** test bay. However, resettings must be undertaken when changes occur to the operating parameters.

[0006]   **British patent document** GB 2 308 675 A discloses an arrangement and a method for driving an optical modulator[. The printed publication] **and** describes the setting of a chirp parameter[. Monitoring] **where monitoring** the modulated signal is performed at the receiving end[,] in order to set the chirp parameters via a back channel for pulse compression.

[0007]   **British patent document** GB 2 316 821 A describes an optical time-division multiplex system which compensates the chromatic dispersion of the transmission path by means of controlled chirping of the transmitted signal. Monitoring of the modulated signal is not provided.

[0008]   [From [sic] the earlier]**Earlier European patent** application EP 0 971 493 A1 likewise describes a method for compensating dispersion and nonlinearities in optical communication systems. In this system, however, it is, for example, the error rate which is measured and the transmission level which is controlled as parameters. Both

measures do not appear to be expedient in modern optical systems.

SUMMARY OF THE INVENTION

[0009]   It is therefore the object of the invention to [specify]**provide** a method and an [arrangements {sic}]**arrangement** for permanent optimization of the pulse shape/spectral distribution of an amplitude-modulated optical signal, particularly taking **omtp** account [of] the modulation-induced chirp and the self-phase modulation in optical transmission systems.

[0010]   Achievements of this object are specified in the independent claims. Advantageous developments of the invention are specified in the subclaims.

[0011]   **This object is achieved by a method for optimizing an amplitude-modulated optical signal, comprising the steps of generating the amplitude-modulated optical signal in a modulator by modulating an optical signal with a digital signal; feeding the amplitude-modulated optical signal to a frequency discriminator which outputs a spectral distribution signal; feeding the spectral distribution signal to a control device which is also fed an adjustable reference signal; and generating a control signal which sets an operating point of the modulator by comparing the adjustable reference signal and the spectral distribution signal. The inventive method may further comprise the step of separating a measuring signal which is fed to the frequency discriminator from the amplitude-modulated optical signal. The method may further comprise the steps of determining the spectral distribution signal at a start of a transmission path; and setting the reference signal based on properties of the transmission path. The method may further comprise the steps of determining the spectral distribution signal at a receiving end; and transmitting the spectral**

distribution signal or a control signal generated therefrom to the modulator provided at a transmitting end. The control signal may be obtained during periodically occurring time windows.

[0012]   This object is also achieved by an arrangement for optimizing an amplitude-modulated optical signal, comprising a light source; a modulator having an output, the modulator being fed an optical signal from the light source and a digital signal for amplitude modulation; a frequency discriminator which outputs a spectral distribution signal that is connected to the output of the modulator via a splitter; and a control device with a reference signal setting device which is fed the spectral distribution signal and which generates a control signal which controls an operating point of the modulator. The arrangement may further comprise an adder which is fed the control signal and the digital signal, an adder output being fed to a modulation input of the modulator.

[0013]   The measures according to the invention consist [in] of using quality criteria for optimal modulation of the optical signal to set the operating point of the modulator and [to maintain] maintaining the optimum setting by [means] way of a control loop.

[0014]   An advantageous and simple solution is to derive a measuring signal from the modulated optical digital signal and feed it to a frequency discriminator. The output signal of the [latter is [sic] led] frequency discriminator is transmitted via a control device [[sic]] which determines the operating point of the modulator.

[0015]   If the measuring signal is tapped at the receiving end, the properties of the transmission path can be taken into account [by means of] via an adjustable reference

signal. The output signal of the modulator is set so as to produce an optimal received signal.

[0016]   If a back channel[,] (as a rule, a service channel[,]) is available, a measuring signal can be tapped from the baseband signal and evaluated. The spectral distribution signal output by a phase discriminator, or a control signal generated therefrom, will be transmitted to the source of the signal, **i.e.,** the modulator.

BRIEF DESCRIPTION OF THE DRAWING

[0017]   The invention is explained in more detail with the aid of an exemplary embodiment. **The Figure is a schematic block diagram showing**~~Figure 1 shows~~ **a first exemplary embodiment with spectral appraisal.**

[~~In the drawing:~~]

[~~Figure 1 shows~~] [~~a first exemplary embodiment with spectral appraisal.~~]

DETAILED DESCRIPTION OF THE INVENTION

[0018]   **The** Figure[~~1~~] shows a first exemplary embodiment of a control loop for optimizing the modulation-induced chirp. The block diagram shows only **the** modules essential to the invention. A laser provided as a narrow-band light source 1 supplies an optical signal OS of high frequency, which is fed to a modulator 2. The [~~latter~~]**optical signal** is [~~submitted~~]**subjected** to amplitude modulation by [~~means~~]**way** of a digital signal DS (on-off keying). The modulated optical signal OSM, output by the modulator, is fed into an optical conductor of a transmission path 3 and transmitted. A measuring signal OMT of low power is tapped from the modulated signal via a splitter (coupler) 4 and fed to a frequency discriminator 5. The [~~latter~~]**fequency discriminator** can include, for example, an optical filter whose edge, which is as rectilinear as possible, is used for frequency demodulation. [~~The demodulated optical signal is~~

~~converted into an electric spectral distribution signal SV and fed to a control device 6. The~~] [~~latter is fed as reference input~~] [~~an adjustable reference signal RS~~] [~~which~~] [~~is generated via a reference setting device~~] [~~7,~~] [~~a voltage divider in the example~~] [~~. The control device supplies~~] [~~as~~] [~~manipulated variable a control signal SR which sets the operating point of the modulator and thereby optimizes the transient chirp of the modulated optical signal even in the case of changes in the component properties.~~]

[0019]   The demodulated optical signal is converted into an electric spectral distribution signal SV and fed to a control device 6. The ~~latter is fed as reference input~~spectral distribution signal SV is fed as a reference input; an adjustable reference signal RS ~~which~~ is generated via a reference setting device ~~7,~~ 7 (a voltage divider in the example). The control device supplies ~~as~~as a manipulated variable a control signal SR which sets the operating point of the modulator and thereby optimizes the transient chirp of the modulated optical signal even in the case of changes in the component properties.

[0020]   An optimum setting is given when the receive signal is optimal. A measurement at the receiving end is actually required for this purpose. However, a compact replacement transmission path used for the setting likewise permits an exact setting. The spectral distribution signal serves as a criterion during setting. A specific envelope of the modulated signal corresponds to this criterion, and can likewise serve as a criterion.

[0021]   If the properties of the transmission path are known, they are already taken into account during setting, and the spectral distribution (or a pulse shape) is set so as to produce optimal receiving conditions.

[0022]   Since the spectral distribution signal SV can be weakly dependent on the [~~on the [sic]~~]bit sequence of the digital signal, it can be expedient to have a time window ZF during which specific bit sequences are transmitted and the control signal is determined.

[0023]   [~~It remains to add that the~~]<u>The</u> control signal RS and the digital signal can be combined by an adder, and the aggregate signal is then fed to the modulation input of the modulator.

[0024]   As in the arrangement illustrated in [~~figure~~]<u>Figure</u> 1, it is also possible, of course, to appraise the spectral distribution of a modulated optical signal at the receiving end, and a corresponding spectral distribution signal or else the control signal derived therefrom [~~is transmitted [sic]~~]<u>may be provided</u> to the transmitting part.

[0025]   <u>The above-described method and apparatus are illustrative of the principles of the present invention. Numerous modifications and adaptations will be readily apparent to those skilled in this art without departing from the spirit and scope of the present invention.</u>

[Abstract]

[Method and arrangement for optimizing the pulse shape of an amplitude-modulated optical signal] **ABSTRACT**

The influences on transmission quality caused by chirp and self-phase modulation are at least largely corrected by [means] **way** of an optimally set operating point of the modulator (2). Suitable criteria are obtained in control loops in order to maintain the optimal setting.

[Figure 1]

LIST OF REFERENCE SYMBOLS

DS	Digital signal
DD	Demodulated digital signal
1	Laser
2	Modulator
3	Optical conductor
4	Splitter
5	Discriminator
6	Control device
7	Reference setting device
RS	Reference signal
OS	Optical signal
OSM	Amplitude-modulated optical signal
OMT	Measuring signal
SV	Spectral distribution signal
SF	Control signal
ZF	Time window
8	Summing device
9	Receiving device
10	Optoelectric transducer
11	Amplifier
12	Decision circuit
13	Data output
14	Measuring instrument appraising device
15	Evaluation device
16	Controller
17	Modulation input
18	Transmitting device
19	Receiving device
SE	Setting signal

FIG

NARROW BAND LIGHT SOURCE 1

MODULATOR 2

OSM 3

4

FREQUENCY DISCRIMINATOR 5

CONTROL DEVICE 6

REFERENCE SETTING DEVICE 7

DS

OS

OSM

OMT

SR

ZF

SV

RS